THAT WHICH IS CLAIMED:

1. A method of producing nitrogen trifluoride, comprising:

providing a reactor comprising a mixing zone and a reaction zone in fluid communication with the mixing zone;

feeding gaseous fluorine into the mixing zone of the reactor;

feeding liquid ammonium acid fluoride into the mixing zone of the reactor;

feeding a working fluid vapor jet into the mixing zone of the reactor, wherein the working fluid vapor jet transfers kinetic energy into the mixing zone, the kinetic energy dispersing the gaseous fluorine within the liquid ammonium acid fluoride;

reacting the liquid ammonium acid fluoride with the fluorine dispersed therein to produce nitrogen trifluoride as the liquid ammonium acid fluoride and fluorine pass through the reaction zone in the reactor; and

removing a gaseous reaction product stream from the reactor, the reaction product stream comprising nitrogen trifluoride and the working fluid vapor.

2. The method of Claim 1, wherein the working fluid is a hydrogen halide.

3. The method of Claim 1, wherein the working fluid is a hydrogen fluoride.

4. The method of Claim 1, wherein the ammonium acid fluoride has an acid-base stoichiometry of $NH_4M_yF_z(HF)_x$, wherein M is a metal selected from the group consisting of Group IA through VA, Group IB through VIIB and Group VIII of the Periodic Table of Elements or mixtures thereof; y is 0-12; z is 1-12; and x is the melt acidity value.

5. The method of Claim 1, wherein the ammonium acid fluoride has an acid-base stoichiometry of $NH_4F(HF)_x$, wherein x is the melt acidity value.

6. The method of Claim 5, wherein the melt acidity value of the liquid ammonium acid fluoride is about 1.2 to about 2.4.

7. The method of Claim 6, wherein the melt acidity value of the liquid ammonium acid fluoride is about 1.4 to about 2.2.

8. The method of Claim 1, wherein the liquid ammonium acid fluoride has a temperature of about 100 to about 200°C.

9. The method of Claim 8, wherein the liquid ammonium acid fluoride has a temperature of about 130 to about 180°C.

10. The method of Claim 1, wherein the liquid ammonium acid fluoride has a pressure of about 50 to about 400 kPa.

11. The method of Claim 10, wherein the liquid ammonium acid fluoride has a pressure of about 100 to about 200 kPa.

12. The method of Claim 1, wherein the ratio of the reaction zone volume to the sum of the volumetric flow rates of the gaseous fluorine and the liquid ammonium acid fluoride is at least about 0.5 seconds.

13. The method of Claim 12, wherein the ratio of the reaction zone volume to the sum of the volumetric flow rates of the gaseous fluorine and the liquid ammonium acid fluoride is at least about 2.0 seconds.

14. The method of Claim 1, wherein the molar ratio of the working fluid vapor jet to the gaseous fluorine is greater than about 1:1.

15. The method of Claim 14, wherein the molar ratio of the working fluid vapor jet to the gaseous fluorine is greater than about 5:1.

16. The method of Claim 1, wherein the molar ratio of the liquid ammonium acid fluoride to the gaseous fluorine is greater than about 2,000:1.

17. The method of Claim 16, wherein the molar ratio of the liquid ammonium acid fluoride to the gaseous fluorine is greater than about 10,000:1.

18. The method of Claim 1, further comprising separating the gaseous reaction product stream into a gaseous nitrogen trifluoride product stream and a liquid working fluid stream.

19. The method of Claim 18, further comprising:

pressurizing the liquid working fluid stream to a pressure of about 250 to about 1600 kPa;

vaporizing the pressurized liquid working fluid stream to form a working fluid vapor; and

feeding the working fluid vapor through a nozzle to form the working fluid vapor jet.

20. The method of Claim 19, wherein said vaporizing step comprises heating the pressurized liquid working fluid stream with the heat of reaction generated in the reaction zone of the reactor.

21. A method of producing nitrogen trifluoride, comprising:

providing a reactor comprising a mixing zone and a reaction zone in fluid communication with the mixing zone;

feeding gaseous fluorine into the mixing zone of the reactor;

feeding liquid ammonium acid fluoride into the mixing zone of the reactor, the ammonium acid fluoride has an acid-base stoichiometry of $NH_4F(HF)_x$, wherein x is the melt acidity value, the melt acidity value being about 1.2 to about 2.4;

feeding a hydrogen fluoride vapor jet into the mixing zone of the reactor, wherein the working fluid vapor jet transfers kinetic energy into the mixing

zone, the kinetic energy dispersing the gaseous fluorine within the liquid ammonium acid fluoride;

reacting the liquid ammonium acid fluoride with the fluorine dispersed therein to produce nitrogen trifluoride as the liquid ammonium acid fluoride and fluorine pass through the reaction zone in the reactor; and

removing a gaseous reaction product stream from the reactor, the reaction product stream comprising nitrogen trifluoride and the hydrogen fluoride vapor,

wherein the molar ratio of the hydrogen fluoride vapor jet to the gaseous fluorine is greater than about 3:1 and the molar ratio of the liquid ammonium acid fluoride to the gaseous fluorine is greater than about 5,000:1.

22. The method of Claim 21, further comprising separating the gaseous reaction product stream into a gaseous nitrogen trifluoride product stream and a liquid hydrogen fluoride stream.

23. The method of Claim 22, further comprising:

pressurizing the liquid hydrogen fluoride stream to a pressure of about 250 to about 1600 kPa;

vaporizing the pressurized liquid hydrogen fluoride stream to form a hydrogen fluoride vapor; and

feeding the hydrogen fluoride vapor through a nozzle to form the hydrogen fluoride vapor jet.

24. The method of Claim 23, wherein said vaporizing step comprises heating the pressurized liquid hydrogen fluoride stream with the heat of reaction generated in the reaction zone of the reactor.

25. An apparatus for producing nitrogen trifluoride, comprising:

a reactor comprising a mixing zone, a reaction zone in fluid communication with said mixing zone, and a product outlet;

a gaseous fluorine feed supply in fluid connection with said mixing zone of said reactor;

a liquid ammonium acid fluoride feed supply in fluid connection with said mixing zone of said reactor;

a working fluid vapor supply in fluid connection with said mixing zone of said reactor; and

at least one nozzle operatively positioned in fluid connection with said working fluid vapor supply upstream of said mixing zone of said reactor.

26. The apparatus of Claim 25, wherein said working fluid vapor supply is a hydrogen halide vapor supply.

27. The apparatus of Claim 26, wherein said working fluid vapor supply is a hydrogen fluoride vapor supply.

28. The apparatus of Claim 25, further comprising a separator in fluid communication with said product outlet of said reactor and operatively positioned to separate a liquid working fluid stream from a gaseous nitrogen trifluoride stream, said separator comprising a working fluid outlet and a nitrogen trifluoride outlet.

29. The apparatus of Claim 25, wherein said working fluid vapor supply comprises:

a liquid working fluid supply; and

a heat exchanger having an inlet and an outlet, said inlet of said heat exchanger being in fluid communication with said liquid working fluid supply, said outlet being in fluid communication with said nozzle.

30. The apparatus of Claim 29, wherein said heat exchanger is positioned with said reactor.

31. The apparatus of Claim 25, wherein said reactor further comprises at least one internal partition defining a flow path between the mixing zone and the reaction zone within said reactor.